Introduction to the BTeV Project

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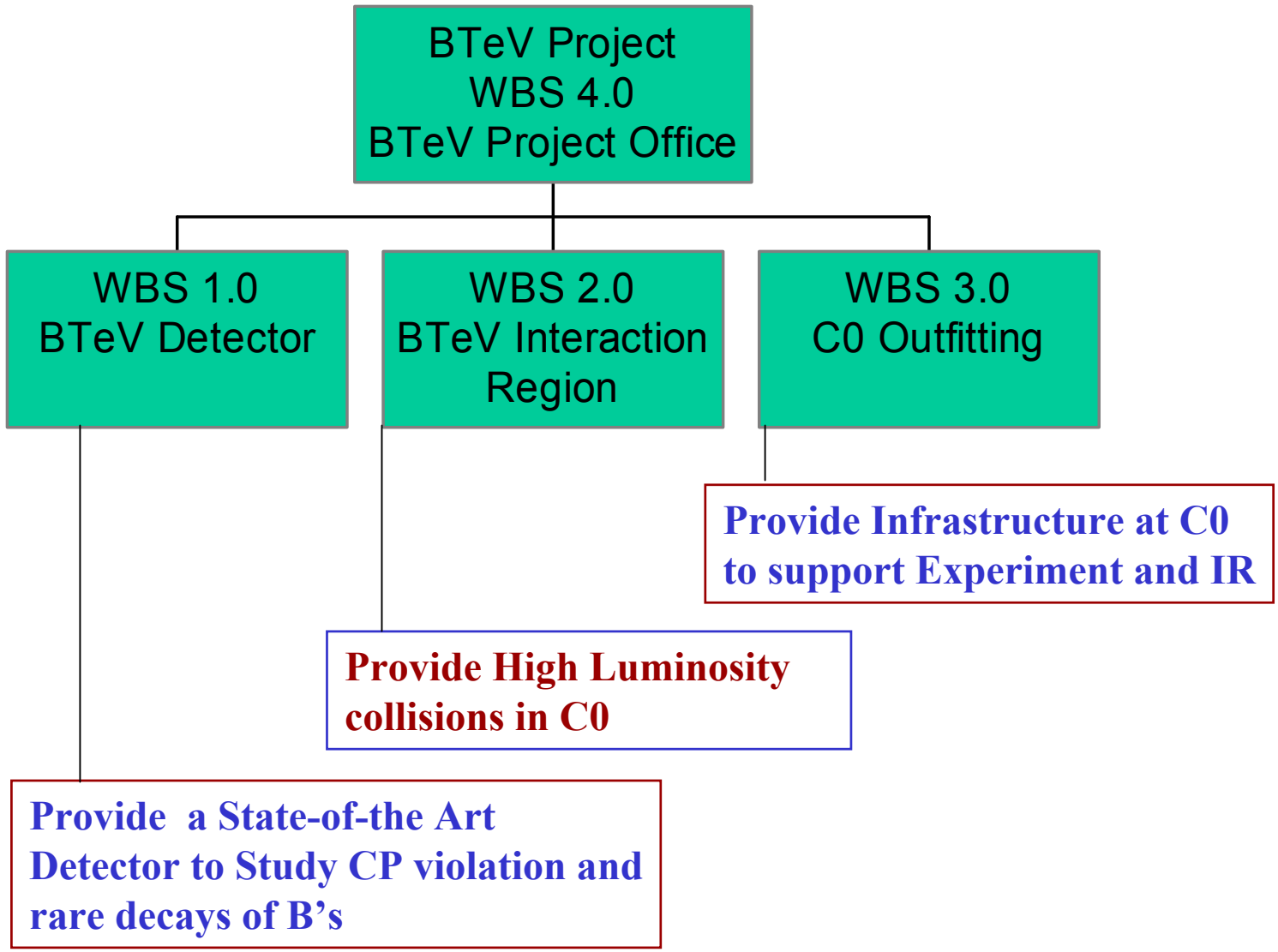
Fermilab Director's CD2/3a Review

Sept. 28-30, 2004

Overview

- The BTeV Project
  - WBS 1.0 – the BTeV Detector, including the Trigger and Data Acquisition System
  - WBS 2.0 – the Interaction Region
  - WBS 3.0 – C0 Outfitting
  - WBS 4.0 – BTeV Project Office, Project Management
- Project Organization and Status
- Project Management Documentation
- Cost and Budget
  - Whole Project
  - FY05
- Summary

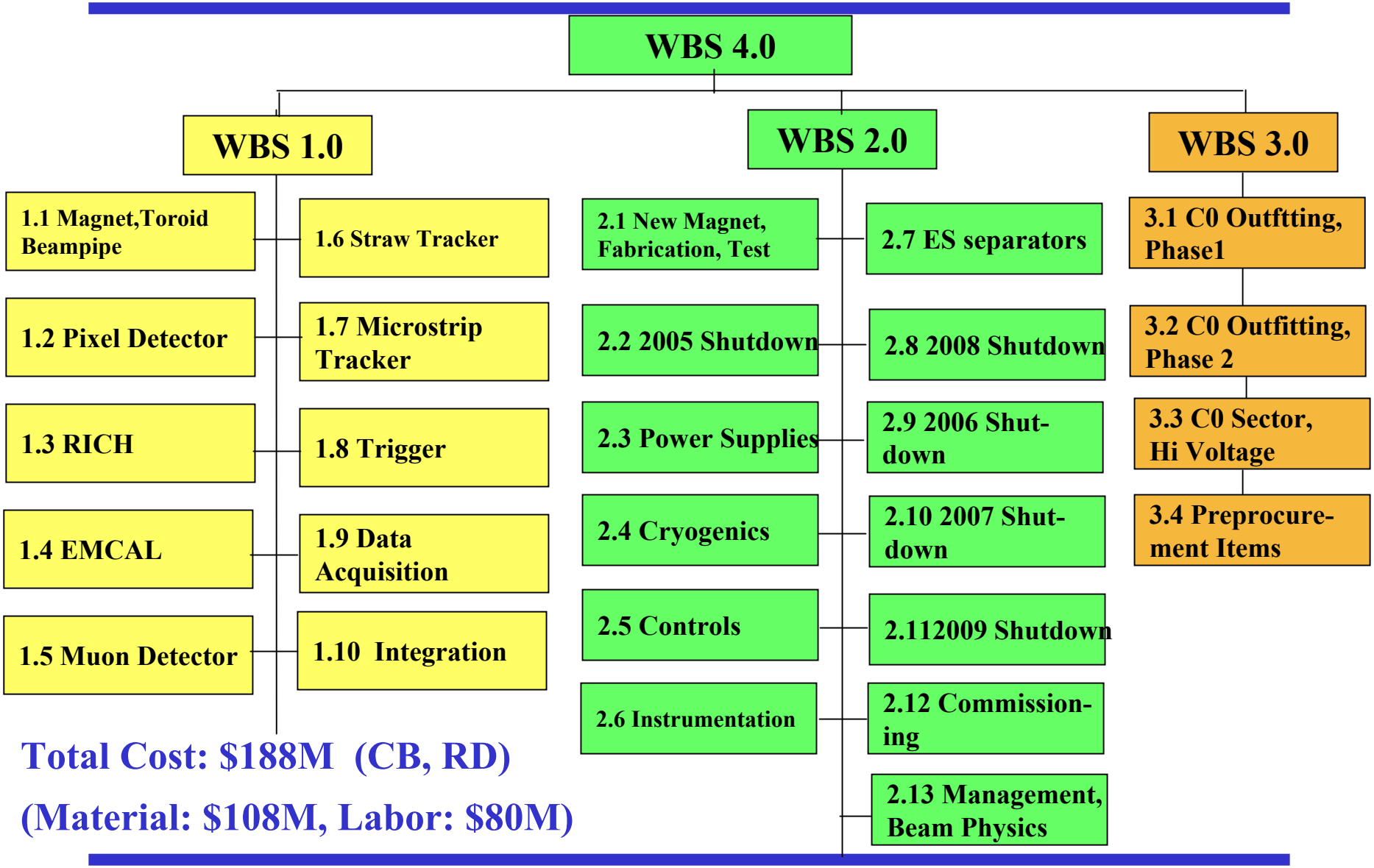
Introduction



Comment on Status of Subprojects

- The designs of the three subprojects now fairly mature
  - **The detector has been designed starting with a simulation effort in 1996 and then a substantial R&D effort beginning in 1998. It has a nearly complete technical baseline.**
  - **In Nov. 2003, FNAL decided to implement a "custom IR" based on new magnets, rather than to reuse components from existing installations. P5 supported this. This required design of a new low-β insertion and the construction and installation of the components. It has progressed rapidly and now has a Preliminary Technical Design Report.**
  - **The C0 Collision Hall and Assembly Area was built in 1999-2000, but was not outfitted with even minimal facilities. This project will complete the basic infrastructure to permit safe utilization and then construct and outfit the counting rooms and provide the power and cooling required for BTeV and the IR, etc. It is past the conceptual design level and is ready for final engineering.**

Organization

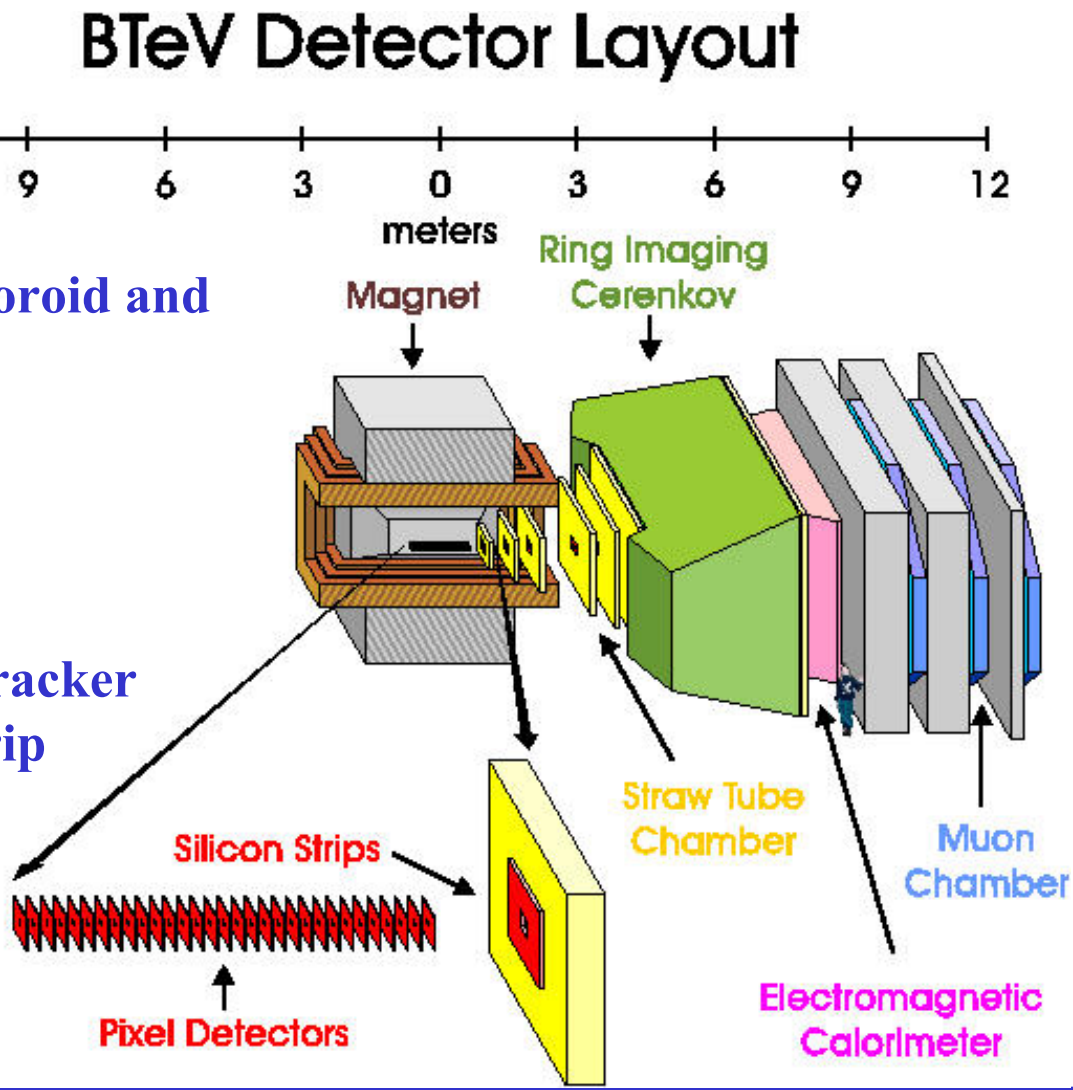


Total Cost: $188M (CB, RD)

(Material: $108M, Labor: $80M)

Work Breakdown Structure - Detector WBS 1.0

1.1 Vertex Magnet, Toroid and Beam Pipe
1.2 Pixel Detector
1.3 RICH
1.4 EMCAL
1.5 Muon Detector
1.6 Forward Straw Tracker
1.7 Forward Microstrip tracker
1.8 Trigger
1.9 Data Acquisition
1.10 Installation, Integration,etc (I&I)



Level 2 Managers WBS 1.0

1.1 Magnets, Toroids, Beampipes ($2.5M)	Chuck Brown
1.2 Pixel Detector ($20.8M)	Simon Kwan
1.3 Ring Imaging Cherenkov($16.5M)	Marina Artuso, Tomasz Skwarnicki
1.4 Electromagnetic Calorimeter ($20.8M)	Yuichi Kubota
1.5 Muon Detector ($6.0M)	Paul Sheldon, Will Johns
1.6 Forward Straw Tracker ($12.7M)	Alan Hahn
1.7 Forward Silicon Microstrip($10.0M)	Luigi Moroni
1.8 Trigger ($16.1M)	Erik Gottschalk
1.9 Event Readout and Control ($17.1M)	Klaus Honscheid, Margaret Votava
1.10 Integration ($12.2M)	Joe Howell

NOTE: UNLESS OTHERWISE STATED, COSTS ARE FULLY BURDENED, WITH CONTINGENCY, IN FY05 $

Detector Technical Status WBS 1.0

- We have had a highly efficient R&D program which is succeeding on all fronts
- The BTeV Detector design has been quite stable for several years, with changes mainly to simplify design or reduce costs, e.g.
  - **We have changed the design of the pixel support, cooling, and vacuum systems following the recommendations of previous reviews.**
  - **We have simplified the trigger design by using a commercial switch for sorting the data in Level 1 and have replaced Level 1 DSPs with Microprocessors. This lowers cost and schedule risk and has been encouraged by our reviewers. This was done through the formal BTeV change control procedure.**
- No "gotcha"s. Many "plans" in 2000/2001/2002 are well on their way to realization today. **Test beam work at Fermilab has begun again and most detectors have used it. We also have a very successful ongoing test beam program at IHEP/Protvino**
- There is a Preliminary Technical Design Report that is the technical baseline for the detector.

Detector Cost and Schedule

- We have implemented a "staged schedule" for the detector construction and installation that will be described in detail in the next talk.
- The key goal is to have a realistic and achievable schedule with the proposed funding profile that maintains our physics competitiveness with respect to LHCb. The way we achieve this is:
  - **To install on the original 2009 schedule the portion of the detector that allows us to do the physics where LHCb is able to compete with us**
  - **To install in 2010 those portions of the detector that are unique to BTeV and where LHCb cannot really compete**
- The "staged schedule" is now our baseline and is the one presented in this review. **All detector subprojects have at least 9 months of float.**
- We have also developed a commissioning plan to demonstrate that the first run will be a physics run
- **The IR and C0 Outfitting are not involved in the staging.**

Interaction Region WBS 2.0

- The custom design produces a β* of 35 cm, same as at B0 and D0. This will give BTeV the same luminosity as CDF orD0. **BTeV's luminosity need is consistent with the lab's current plan for RUN II. Recent progress on the Luminosity has been very encouraging.**
- Recent design work has resulted in greater separation of the beams at the first parasitic crossing and also led to simplifications that reduced the types of correctors and consequently the number of spares. **These changes went through the BTeV change control process.**
- Based on recommendations from our CD1 review, we decided to negotiate with BNL to build the correctors. If the negotiation is successful, this will reduce schedule risk but it has increased the cost.
- Significant design work has been done and reviewed by AD. A list of elements has been prepared and is the basis of a cost estimate and schedule. **There is a Preliminary Technical Design Report that will be the technical baseline for the IR.**
- **Schedule float is now about 11 months and is based on changes in the funding profile for the IR, better knowledge of vendor capabilities, and changes in the design**

Organization

Level 2 Manager –Mike Church

2.1 New Magnets ($25.4M)	Jim Kerby, Deepak Chichili John Tompkins
2.2 2005 Shutdown ($1.0M)	Peter Garbincius
2.3 New Power Supplies ($3.4M)	George Krafczyk
2.4 Cryogenic Systems ($1.5M)	Jay Theilacker
2.5 Controls ($0.7M)	Sharon Lackey
2.6 Instrumentation ($0.2M)	Randy Thurman-Keup
2.7 Electrostatic Separators ($0.9M)	Roger Bossert
2.8 2008 Shutdown ($1.5M)	Rob Reily
2.9 2006 Shutdown (currently no work planned)	Rob Reilly
2.10 2007 Shutdown ($0.7M)	Rob Reilly
2.11 2009 Shutdown ($2.2M)	Rob Reilly
2.12 Hardware commissioning ($0.2M)	Gerry Anala
2.13 Overall project management	Mike Church (IR Leader),Peter Garbincius, John Johnstone (beam physics)

Total Cost= $37.7M,

M&S= $20.3M, Labor =$17.4M

IR Design Plan WBS 2.0

- The plan is to use modified LHC quadrupoles because they are the elements we have the most recent experience with at FNAL.
  - They need to run at 4.5° K rather than the design 1.9° K.
  - The cryostat will be reduced in diameter so the magnet doesn't intersect the tunnel floor. Work has already been done on this.
- The corrector package design and power lead issues are now resolved
  - Will procure correctors from BNL – agreement being negotiated
  - Have demonstrated capacity of existing HTS leads (rated at 6K Amps) to carry 10 K Amps required. Some existing leads available from "Spares" at FNAL, others will have to be purchased.

C0 Outfitting WBS 3.0

- **Site Construction: hardstands, utility pads, gas shed,…**
- **Mezzanine construction: walls, roofing, flooring, finishes (painting, carpeting), computer floor for counting room**
- **Elevators**
- **Cooling and HVAC: Chillers, Computer room cooling, Natural Gas**
- **Plumbing**
- **Electrical: lighting, substations, emergency generator, HV feeders**
- **Fire Detection**

This subproject has an Advanced CDR and a project team, including an engineer. It is divided into 3 phases for budgetary and technical reasons, but in a manner that always provides the access and facilities needed to carry out detector and IR related activities in the C0 area.

Project Organization and Cost WBS 3.0

- **The Level 2 manager is Tom Lackowski of Facilities Engineering Support Section (FESS)**
- **The task coordinator is Emil Huedem. He will have a construction coordinator and a procurement administrator**

3.1 C0 Outfitting Phase 1 **($2.4M)**

Provides basic services and safety to make this a minimally functional building

3.2 C0 Outfitting Phase 2 **($2.9M)**

Provides power, cooling, and other services and facilities to operate the BTeV detector and electronics

3.3 C Sector High Voltage Power Upgrade **($0.9M)**

Brings in power from substations to fully support BTeV

3.4 Pre-procurement items **($0.8M)**

3.5 CDR ACDR & Project Reviews ($0.1M)

Total Cost = $7.1M, M&S= $5.9M, Labor $1.2M

Project Office Staffing WBS 4.0

- Project Director: Joel Butler
- Deputy Project Director: Sheldon Stone
- Project Manager: Michael Lindgren*
- Scheduler: Bill Freeman*
- Budget Officer: Suzanne Pasek*
- Project Engineer – opening approved by FNAL**
- Project Electronic Engineer: Ed Barsotti
- Project Mechanical Engineer: Joe Howell
- Project Software Engineer: Margaret Votava
- Consultant: Bob Downing
- Administrative Support: Lauren Curry
- Quality Assurance/Procurement – to be posted for internal transfer**
- Integration Physicist – approval to recruit internally**
- Procurement Liaison in BSS: Joe Collins
- Safety Liaison in PPD: Martha Heflin

* = added since January '04; ** = recently approved

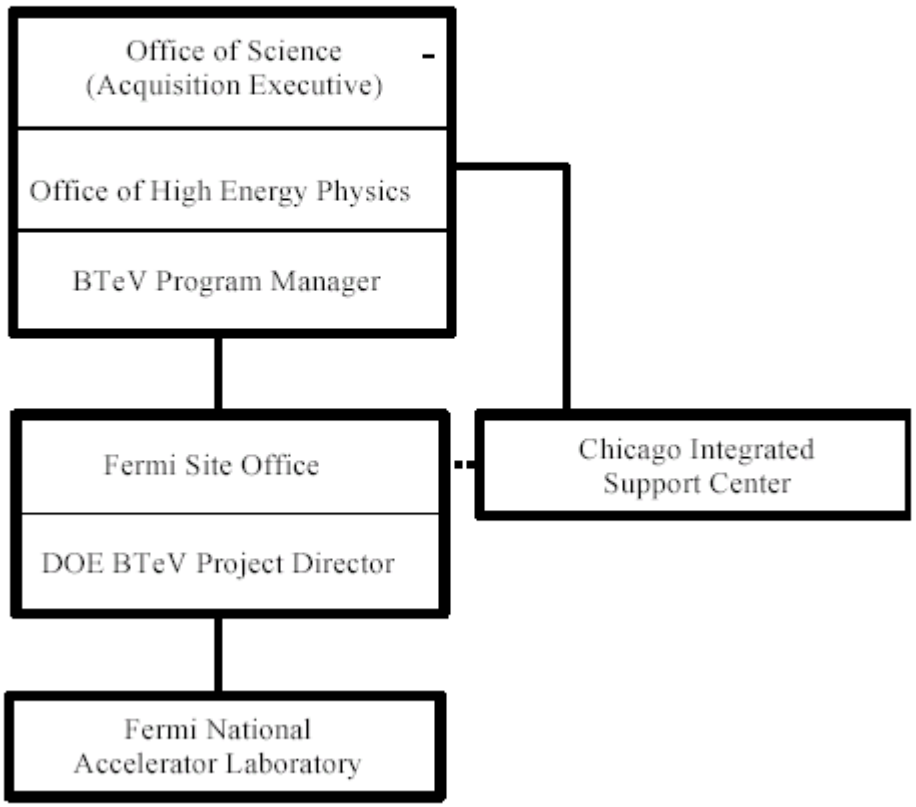
Total Cost = $8.4M, M&S= $0.8, Labor $7.6M

Project Organization

- The BTeV Project is part of a larger organization extending through lab management, through the DOE Fermilab Site Office, OHEP, into the Office of Science, to the highest levels of DOE
- All these groups work together to successfully execute the BTeV Project, I.e. to accomplish its scope on schedule and within budget
- The management and oversight roles, including change control, are described in
  - The Preliminary Project Execution Plan **(PEP)** for the B Physics at the Tevatron Project at the Fermi National Accelerator Laboratory
  - The Preliminary Project Management Plan **(PMP)** for the BTeV Project
- Note the the BTeV Organizational Breakdown Structure closely parallels the Work Breakdown Structure.

DOE Organization – from the PEP

Figure 4.1
BTeV Project
Project Management Organization



Fermilab –BTeV Collaboration-BTeV Project from PMP

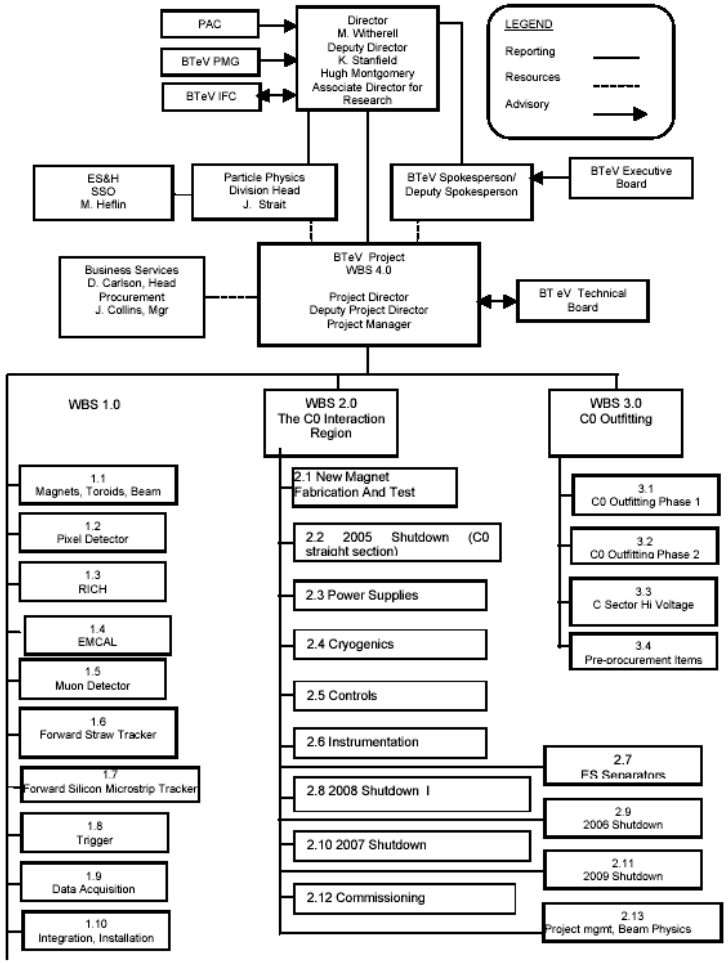


Figure 1 Organization chart for the BTeV Project through WBS Level 2

- BTeV does not have unusual ES&H issues and has received a NEPA Categorical Exclusion
- A Preliminary Hazard Assessment Document has been written and has been judged adequate for CD1 by DOE.
  - The conclusion is that "operations at BTeV are characterized as low hazard."
- A Preliminary Safety Assessment Document (PSAD) has been written and is ready for review.
- We have a Safety Liaison – Martha Heflin of Particle Physics Division
  - There are four FNAL divisions and one section involved in BTeV and attention is being given to making sure there are clear lines of responsibility

BTeV Resource Loaded Cost and Schedule

- The project is being managed using an integrated suite of project management software from WELCOM, inc.– Open Plan (scheduler), COBRA, and WelcomHome.
- The cost estimate is derived from a complete, task-oriented WBS. Realistic assumptions are made about the production model. We have worked hard to include integration activities in a complete and consistent manner
- Estimate starts in FY2005, when we will transition from an mainly an R&D Project to mostly a construction project. IT IS IN FY2005 DOLLARS.
  - **Includes contingency, labor rates for all institutions including Fermilab, overhead on labor.**

Contingency

- We develop a bottoms up contingency based on maturity of design using a consistent methodology for M&S and labor. It results in a contingency of about 36%. We believe this is reasonable because
  - **The BTeV detector and C0 IR are new but many pieces have been or are being built elsewhere, so some parts can have relatively low contingency.**
  - **Our Cost Estimate is unusually complete for this stage in the project. In many cases, we are dealing with known vendors and have solid quotes**
  - **The scope has been stable for several years**
  - **There are parts that use new or unproven technologies and those do have much higher contingencies**

Cost and Schedule Principles

- In the following, we discuss the balance between our budget availability and our need for budget authority based on the **"Staged Schedule"** that is our proposed baseline
- We focus on our need for Budget Obligation Authority vs the availability of Budget Obligation Authority
- For this, we use a schedule
  - **that lumps all schedule float at the end;**
  - **that has the budget authority for M&S available at the contract award;**
  - **that assumes labor is paid linearly across the performance period;**
  - **that respect fund types; and**
  - **that takes into account DOE Critical Decision dates and the likelihood of a continuing resolution in FY05 that impacts "new starts."**
- Note that in addition to the Project "Total Estimated Cost", the "TEC", we have three other fund sources
  - **RD in FY05 and 06**
  - **IR Spares**
  - **INFN funds**

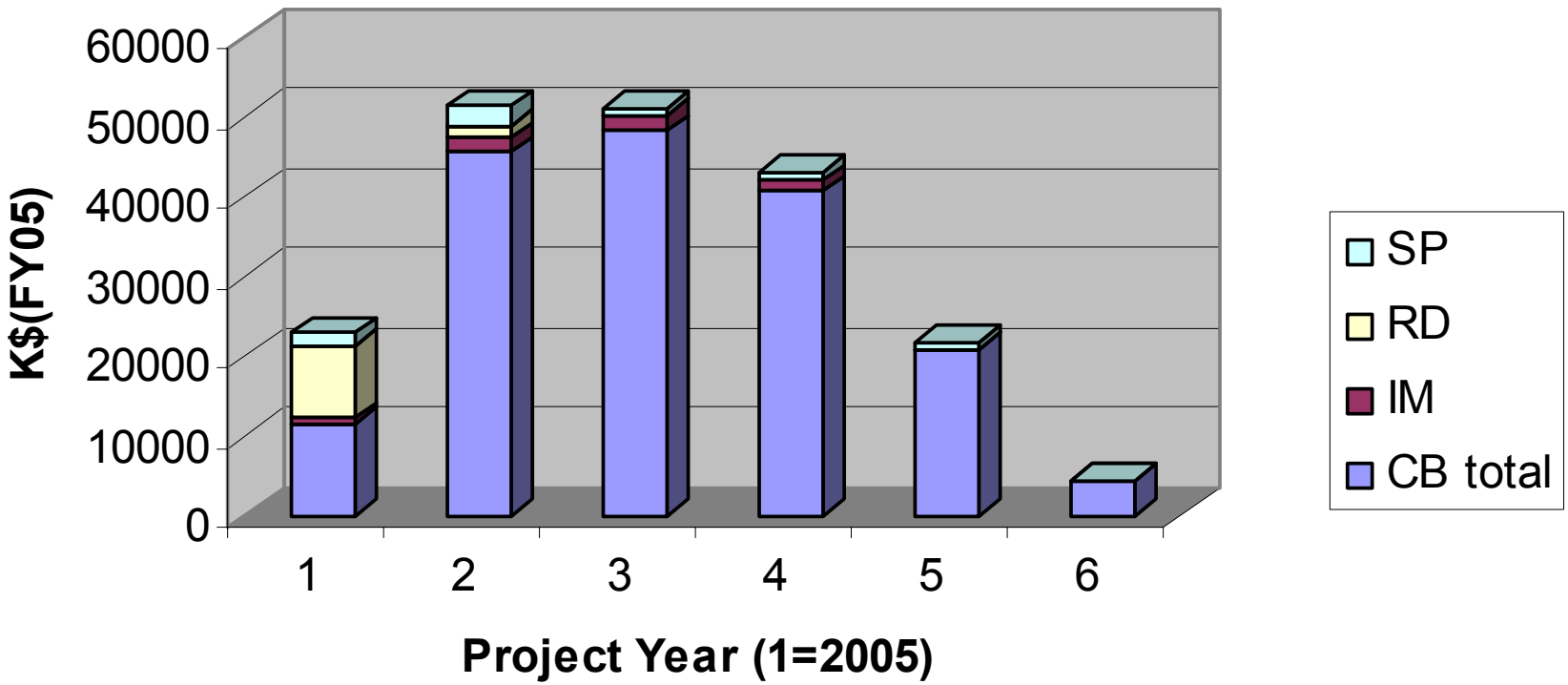
Total Cost (FY05$)

Activity ID	Base Cost ($)	Material Contin-gency (%)	Labor Contin-gency (%)	Total FY05	Total FY06	Total FY07	Total FY08	Total FY09	Total FY10	Total FY05-10
1.1	2,029,294	25	25	166,497	1,164,074	803,999	301,897	103,343	0	2,539,810
1.2	14,569,875	44	41	2,548,158	7,143,872	5,900,544	4,580,606	616,427	0	20,789,607
1.3	12,127,468	37	29	461,538	4,682,449	6,661,545	3,812,171	857,036	7,349	16,482,088
1.4	15,366,701	36	28	478,212	2,402,126	5,559,366	7,771,404	4,550,707	0	20,761,815
1.5	4,428,627	41	28	487,380	2,428,341	2,031,839	1,145,468	0	0	6,093,028
1.6	10,039,870	25	28	1,048,389	4,398,143	3,679,327	3,292,013	209,438	44,500	12,671,810
1.7	7,455,226	35	33	1,450,704	2,505,579	3,338,988	2,533,869	155,258	0	9,984,398
1.8	11,133,096	36	65	793,747	2,450,235	4,254,859	3,665,162	4,900,047	19,178	16,083,228
1.9	12,715,418	41	29	526,197	3,027,942	4,175,431	5,225,501	4,057,204	109,104	17,121,379
1.10	7,925,094	23	65	666,943	1,314,152	2,033,094	2,081,802	2,685,831	3,388,136	12,169,958
2.0	28,127,228	31	38	7,070,819	8,817,907	9,998,444	8,399,263	2,937,834	508,757	37,733,024
3.0	5,886,614	22	19	1,344,456	3,036,565	2,746,267	0	0	0	7,127,288
4.0	6,837,105	22	23	1,501,110	1,665,135	1,681,204	1,518,620	1,489,808	574,001	8,429,878
Total	**138,641,616**	**34**	**37**	**18,544,150**	**45,036,520**	**52,864,907**	**44,327,776**	**22,562,933**	**4,651,025**	**187,987,311**

Base Cost = $138.6M, Total Cost = $188.0M, Contingency = 36%
Total M&S = $108M, Total Labor = $80M

This includes fund type CB(MIE) and RD and IM(INFN) from FY05 on. It does not include FY04. It does not include IR spares.

Total Cost by FY (FY05 $)



Lab/DOE Funding Profile($M/AY)

	FY05	FY06	FY07	FY08	FY09/10	Total
$M/AY	13.1	41.2	51.2	51.7	44.9	202.1

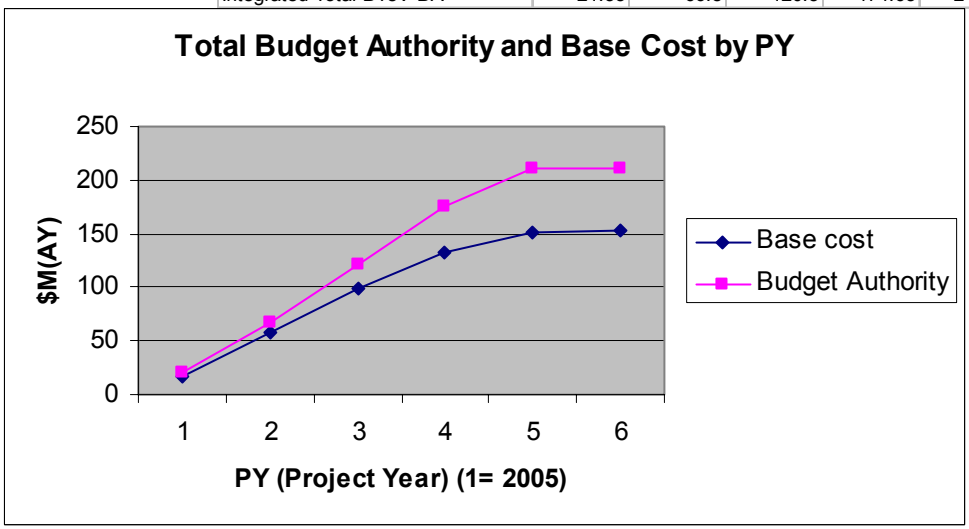
The plan we have put forward is consistent with lab funding profile guidance. The funding profile, which is "back-end" loaded, we have met by

1. **Deferring as many costs as possible, especially components such as computers whose cost fall with time**
2. **By using phased contracts**
3. **By using funds approved for BTeV by INFN. These are available to support the projects that are being worked on by the Italian physicists on BTeV.**
4. **We have forward funding arrangements with universities. So far, Syracuse ($7.5M), Wayne State ($1M), and Vanderbilt ($1M) have approved forward funding for BTeV. We are seeking more forward funding from our other collaborators.**

We presented a schedule based on this profile based on issues raised in the CD1 that was judged to have adequate schedule float

Lab Funding Profile

Cost Profile - M$ AY	FY05	FY06	FY07	FY08	FY09	FY10	
Equipment Base Estimate	8.64	35	38	32	17	3.13	133.77
Contingency	2.8	11.7	13.1	11.6	6.63	2.4	48.23
Total Equipment(CB)	11.44	46.7	51.1	43.6	23.63	5.53	182
Italian InKind	0.6	1.7	1.9	1.8	0	0	6
Italian InKind Contingency	0.2	0.55	0.6	0.65	0	0	2
IR Spares	1.25	1.9	0.9	0.85	0.7	0	5.6
IR Spares Contingency	0.5	0.6	0.3	0.3	0.3	0	2
R&D	6.83	1.25	0	0	0		8.08
R&D Contingency	2.2	0.5	0	0	0		2.7
Total BTeV Costs	23.02	53.2	54.8	47.2	24.63	5.53	208.38
Availability of Funds - M$ AY							
R&D DOE	4.2	2.2	0	0	0	0	6.4
OP DOE	2.1		1.2	1.9	2.4	0	7.6
MIE DOE	6.75	39	50	49.8	42.5	0	188.05
Total DOE	13.05	41.2	51.2	51.7	44.9	0	202.05
Univ Forward Funding	7.5	2	0	0	-9.5	0	0
INFN	0.8	2.25	2.5	2.45	0	0	8
NSF	0	0	0	0	0	0	0
Total Anticipated BA	21.35	45.45	53.7	54.15	35.4	0	210.05
Integrated Total BTeV Base Costs	17.32	57.17	97.97	132.62	150.32	153.45	
Integrated Total BTeV BA	21.35	66.8	120.5	174.65	210.05	210.05	



Other funds are being sought from the US NSF. This is still at the proposal stage and is uncertain. NSF provided key support for the R&D phase

Living with FY05 Budget

- FY05 has some unusual problems
  - **We may not have CD3 until the end of FY05**
  - **We may not have CD3a until the middle of FY05. The current schedule says Q2 '05.**
  - **We have the possibility of the continuing resolution lasting until late winter or early spring**
  - **We are planning to be able to spend CONSTRUCTION MONEY based on CD3a beginning April 1, 05.**
- We will have to deal with this by
  - **Using a mix of R&D funds, MIE funds based on CD2 to complete designs, MIE funds based on CD3a for the second part of the year under Long Lead Time and Time Critical Procurements. If we are given flexibility to spend on some smaller items (<$10K), that would be highly desirable.**
  - **Using Italian funding for the work of BTeV Italian collaborators**
  - **Using forward funding to for some procurements and for contingency.**
  - **Identifying and planning to do what is crucial to keep to the schedule. Prioritizing the least critical tasks and preparing to delay them if the schedule appears threatened.**

Requests for Long Lead Time Procurements

Item	Base cost	Cont	Targ RFP date	Targ. Award Date	Dura-tion (Months)	Finish Date	FF Cand.
C0 Outfitting Phase 1	1,255,733	20%	Jan 05	Apr 05	8	Nov 05	N
Superconductor	$930,000	25%	Jan, 05	Apr 05	15	Jun 06	Y
Correctors	$881,268	40%	NA	Apr 05	7	Oct. 05	N
Cable Insulation	$63,753	40%	NA	Apr 05	15	Jun 06	Y
Steel for IR Quads	$110,000	50%	Feb 05	Apr 05	6	Dec 05	Y
QIE9 Chip	$164,731	50%	Jun 05	Jul –Sep 05*	6	Dec 05-Feb 06	Y

Total Request for Long Lead Time Procurements =$3.41M
Total Candidate Forward Funding (base) = $1.27M

Requests for Time Critical Procurements

Item	Base cost	Cont	Target RFP date	Target Award Date	Duration (Months)	Finish Date	FF Candi-date
Pixel Sensors	48,073	43%	Jun 05	Aug 05	4	Dec 05	Y
Pixel Hybridization	249,308	50%	Mar 05	Jul 05	7	Feb 06	Y
High Density Interconnect	54,859	50%	Jun 05	Sep 05	3	Dec 05	Y*
Coil Handling Fixture (SM3)	25,534	25%	NA	Jul 05	2	Sep 05	N
FY05 Shutdown M&S	397,173	18%	NA	Apr 05-Aug 05	varies	In time for shutdown	N
Cold Mass Tooling	350,796	40%	Apr 05	Jun 05	6	Nov 06	Y*
Coil end Parts	175,000	40%	NA	Apr 05	14	May 06	Y
Quad. Vacuum Vessels	371,200	40%	Jun 05	Aug 05	10	May 06	Y
Cryostat parts	~250,000	40%	Jun 05	Aug 05	10	May 06	Y*

Total Request for Time Critical Procurements = $1.92M
Total Candidate Forward Funding (base) = $1.50M

FY05 Summary

- Total opportunity for FORWARD FUNDING is $2.9M (base cost)
- We include also $1.435M contingency for total of $4.3M
- We can use forward funding for other, smaller(<$10K) items and for added contingency on RD and CB
- **The only labor that is connected to the "construction" is the labor involved in the FY05 Installation Activities for the C0 Straight Section. This is $374,265K base with 30% contingency.**
- The remaining labor is either R&D or Project Engineering and Design under CD2 to arrive at the final design needed for CD3. It is largely in place, both at FNAL and in the universities.

Total Cost:	
OPC	**6.83M**
IM	**0.50M**
CB	**8.74M**
	16.07M

Funding:	
OPC	**6.30M**
IM	**0.70M**
MIE	**6.75M**
FF LL	**2.77M**
Univ FF/C	**4.80M**
	21.25M

Total Long Lead M&S:	**$3.41M**
Total Time Critical M&S:	**$1.92M**
Total Time Critical Labor:	**$ 0.38M**
Total	**$5.71M**
Univ FF LL	**$2.77M**
MIE CD3a	**$2.94M**
MIE CD2/Design	**$3.81**

Summary of Key Points for the Review

- **We have a technically sound, well-defined project scope that will accomplish our physics goals. The technical design has been stable for two years and has only a few options, which are about equal in cost. The design meets our stated requirements. Our R&D program has helped reduce risks**
- **Our cost estimate is quite complete. Our need for money balances our funding guidance. Forward funding authority, now $9.5 M, will allow us to deal with problems with the budget**
- **In the next talk, we will review how we have reorganized our schedule after the CD1 review based on staging the detector. We now have an achievable schedule**
- **The experiment has less "coupling" than hermetic central collider detectors, resulting in lower costs, fewer uncertainties, ease of installation, integration, and commissioning.**
- **We have a plan to cope with the special challenges we expect to arise in FY05. We are ready to get started!**
- **An experienced team is in place to do the project. We are using formal project management techniques.**